Our Journey on the TRAC Drawbridge Competition December- May, 2005-2006

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“The Incredibles”
Getting Started

Verrazano Bridge

Triborough Bridge
Herricks High School Presents

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Decisions, Decisions, Decisions!

I. Planning and Research, Timeline
II. Templates and Tester Consideration
III. Support Design and Construction
IV. Midsection Construction
V. Design of Tracks of the Side of Supports
VI. Pulley System and Gears, Motion of Midsection
VII. Finishing Touches to Conform with Tester, Reducing Weight
Choosing our Bridge

We based our decision on:
- Simplicity of design
- Mobility & portability
- Strength-to-weight ratio
- Snugness of fit
General Principles

- Perfect right angles for the joints
- Limited surface planes
- Designing the bridge to conform with the Pitsco di2000 tester
- Pulley system: using gears for efficient and smooth movement
- Low weight, high strength = high strength-to-weight ratio
Research

We obtained information about the TRAC criteria and requirements
During the course of our constructions, we always analyzed each of our steps. We shared ideas and took detailed notes at each meeting.
Ready, Set, Go! (Objectives and Goals)

- Cross-members and additional supports
- Gear/Pulley system: for smooth ascent and descent.
- Strength-to-weight ratio was maximized
- Midsection: clearance for a 4” h x 2” w boat when raised and 1”h x 2” w for car.
- Bridge Span= 15” across
We decided on the lift bridge. It would consist of:
- Two Towers
- One Midsection
- String/Pulley System for ease of operation
Considerations

Drainage: the tilt of the bridge to allow practical flow of water.
We generated a slant. It was tilted towards the side of the gears.
Rain will drain to a corner.
Considerations

- Contraction/Expansion:
  - Summer: expands
  - Winter: contracts

- Minimizing Weight: removing unnecessary parts of the bridge

- Components for Strength: adding cross-members and suspension from the top
Tools

- Pliers
- Sharptooth saw
- Bubble level ruler
- Digital caliper
- Scissors Jack
Just Do It

Midsection Work

Looking for flaws

Hard at work
Organization: Making our environment safe, clean, and accessible.
Planning out the bridge by not rushing into construction.
Developing a design template for woodwork.
Sharing the Responsibility &
Problem Solving
Supports

Cross- and diagonal-members strengthen the entire structure.

Popsicle sticks were used instead of balsa wood for extra strength and sturdiness.

Maximum strength must be on the bottom of the supports.
Three-way supports:
- Truss design using triangular form.
- Suspension system supports bridge from above.
- Base supports add strength from below.
The Lift System

- Pulley/gear system was developed for efficient maneuver by drilling holes in popsicle sticks.
- Dowel rod connect both supports.
- Three Gears: two were small and one was large.
Four strings instead of one were attached to the midsection. When resting, taut strings helped bear additional load.
Ease of Operation

- Development of tabs/extensions on midsection along the sides of the supports.
- Allowed for smooth lift operation of the midsection.
The Haircut and Weight Reduction

Eliminating the upper section to reduce weight.
Drilling holes into the midsection.
Optimizing the strength-to-weight ratio to make decisions.

Before

After
Safety & Beyond

- Safety goggles were worn at all times
- Incisions were made away from the body
- We worked in a clean, safe environment
- Adult supervision
- Tester template was used to conform dimensions
- We built a functional tester
Testing Process One

- We created paper templates of the tester
- Pitsco di2000 tester was too expensive
- Needed a counterweight, scale, and a method to exert force against the bridge and scale.

1st tester, needed improvement
Testing Process Two

We constructed the scissors/car-jack drawbridge tester
- Frames were built
- Bridge is snugly fit
Modifications

- Focusing on the bottom of the supports
- Additional cross-braces along the bottom
- Stabilizing the midsection and inserting diagonals beneath the bridge
- Retesting
- Two prototypes were built and destroyed in testing.
Maximum Load: holds over 250 lb
Bridge Weight: 105 g
Strength-to-Weight Ratio: 1,080.95

\[
\frac{(250 \text{ lbs} \times 454 \text{g/lb})}{105 \text{ g}} \]

Strength (g)/weight (g)

If a 1g stick were to be added to the bridge, how would we decide whether or not to incorporate it?

\[
\frac{(275 \text{ lbs} \times 454 \text{g/lb})}{106} = 1,117.83 \text{ (ratio increased)}
\]

“Go or No Go Decision” for adding additional materials to the bridge.
Driver Safety

- Side Rails
- Even and level surface that is enclosed.
- Automated STOP sign
- Supports of midsection act as a barrier (Fail-Safe system)
Quality Control

- Inspected the original materials, and discarded defective ones
- Smooth pathways
- Sandpaper
- Tester and caliper
- Toothpick glue work
December, 2005: notified of project
January, 2006: project proposal and portfolio submission and completion of bridge prototype.
February, 2006: notification of finalists
March-May, 2006: PowerPoint Presentation, display board and bridge improvements.
Acknowledgements

Special Thanks To:

Mr. Richard Quan: Our great science research teacher who spent long nights inspiring support for the construction and development of our project.

Our families: for providing morale and places for us to work.

AASHTO TRAC: for this great opportunity and experience.

Mr. Tate Jackson: For all the advice and information as well as for visiting Herricks High School from Washington, D.C.

The Sponsors: For financing our expenses.
AASHTO’s TRAC Program would like to thank the following organizations for their generous support of the TRAC Challenge.

**DMJM HARRIS | AECOM**

**HDR | ONE COMPANY Many Solutions™**

**FHWA**

**PARSONS BRINCKERHOFF**

**BENTLEY**

**Baker**
If Susie were to fall down a stairway with bridge in hand, what would we do?
Final Question

SAVE THE BRIDGE!!!
The End
Works Cited

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